Without minerals and vitamins, we cannot use the protein, carbohydrate and fat we consume, nor do our bodies even have a structure. These nutrients that we consume in relatively small quantities are critical to our very existence, and adequate quantities of them are also critical to our quality of life. Knowing a little bit about the essential minerals and vitamins can help us ensure that we take in adequate amounts.

PART 1 - The Minerals was presented in the immediately preceding issue of NHVL, pages 56 - 59.

PART 2 - The Vitamins

As with the minerals, an enormous amount could be written about the various vitamins. To keep the subject brief (and readable!), only the most prominent points will be mentioned.

A vitamin is an organic substance which is required in extremely small amounts and is activated within the body. It cannot be manufactured in the body and so must be supplied in the diet. A vitamin tends to function as a co-factor for enzyme activity. Vitamin D is an interesting case; when it is manufactured in the skin, it is technically a hormone, not a vitamin. But when it is consumed in (animal) food, it is back to being a vitamin.

The various vitamins act together in harmony to achieve a uniform integrated function. Unlike the other nutrients, vitamins don't supply the raw materials for energy, growth or repair. Instead, they enable the body to assimilate and utilise proteins, carbohydrates, fats and minerals.

A subtle aspect of the vitamins is their energy levels - their 'vibrations' - the unexplained energies of life, which are imparted to vitamins during their manufacture in nature’s laboratory, the plant cell. Man’s laboratories cannot manufacture life, so synthetic vitamins have none of these energies, and this is why the best source of vitamins is fresh, raw, whole foods or their juices. If supplements are required, the best form is vitamins extracted from plant or animal tissue (with a preference for the former). Synthetics still do perform functions and can achieve results where there is deficiency, but greater effectiveness is obtained with the more natural sources.

Vitamins are either water soluble or fat soluble. Those that are water soluble are vitamin C and all the B group. All the other major vitamins are fat soluble - A, D, E and K. This has implications for where they tend to be found in the body and how they are eliminated.

VITAMIN C – Ascorbic acid

This is the leading water-soluble antioxidant, although its fame was originally to do with preventing scurvy in sailors at sea for many months at a time without any fresh food. About a century ago, it was discovered that vitamin C is essential for the skin and it doesn’t require much to prevent scurvy. The early sailing ships solved the need with limes, hence the nickname for sailors, ‘limeys’. However, this wonderful nutrient does much more than prevent scurvy.

Functions

Necessary for connective tissue, so it is critical to the integrity of skin, gums, blood vessels, bones and joints.

Is a powerful antioxidant; being water-soluble, it patrols in the blood and tissue fluids preventing and repairing free-radical damage. Hence, it is anti-cancer, anti-heart disease, and so on.

Prevents inflammation of artery walls, that is, prevents atherosclerosis. Also increases conversion of cholesterol to bile salts for elimination.

Prevents cataract in the lens of the eye by preventing oxidation of proteins in the lens.

Necessary for the white blood cells of the immune system - hence is anti-bacterial, anti-viral and anti-histamine.

Necessary for the manufacture of the stress hormones, adrenalin and cortisone. Necessary for normal brain function.

Is a chelating agent, increasing the absorption of iron, zinc, calcium and magnesium.

Detoxifies some carcinogens, some insecticides and nitrosamines.

Deficiency, Toxicity

Deficiency leads to:

Weak collagen in skin, bones, etc.

Poor wound healing.

Poor quality blood vessels - varicose veins.

Loose teeth.

Bleeding gums.

Joint pain.

Severe deficiency can produce anaemia.

Susceptibility to minor infectious illnesses.

Development of cataract.

Toxicity – extremely high intakes of vitamin C can cause diarrhoea; if taken for prolonged period, kidney stones; if ascorbic acid is chewed, tooth erosion.

Sources

All animals make their own vitamin C from glucose, except apes, flying foxes, guinea pigs and humans. Nature has decreed at the outset that we must eat a lot of fruits and vegetables – which is where vitamin C is found.

Vegetables high in vitamin C are (figures are mg/100 gm): red capsicum (170), broccoli (110), Brussels sprouts (110), watercress (100), parsley (100), green (unripe) capsicum (90), kohlrabi (71), red cabbage (69), cauliflower (56), white cabbage (45), chives (55).

Fruits are: guava (240), kiwifruit (73), pawpaw (60), orange (52), lychee (49), lemon (48), strawberry (45), custard apple (43)

Other vegetables and fruits contain lower, but still very significant, levels.

Recommended daily intakes of vitamin C vary widely around the world - in the USA 75 mg
for women and 80 mg for men; in Australia between 30 mg and 60 mg per day. These levels are woefully inadequate. They may prevent scurvy, but vastly greater amounts are needed for all the other vital functions of vitamin C. As an important anti-oxidant, it is 'used up' when the body is eliminating toxins and pollutants and dealing with microbes. It has been estimated that people who smoke require 25 mg of Vitamin C just to counter the toxins from one cigarette.

But we can have too much. The United States has an upper safe limit of 2,000 mg per day, and in some cases, even 500 mg daily might be too much.

**VITAMIN B1 – Thiamine**

**Functions**
Main function is to activate some of the enzymes which ‘burn’ sugar to release energy for the body. If insufficient thiamine, the intermediate compound, *lactic acid*, builds up and can reduce the oxygen-carrying capacity of the blood, and damage nerves and heart muscle.

**Stability**
Destroyed by high heat, such as in deep-frying.

The absorption of thiamine is inhibited by alcohol, and thiamine is rendered unusable by raw fish and the sulphur preservatives in wines, dried fruits and preserved meats.

**Deficiency**
Acute deficiency can cause ‘wet’ *beriberi* in which there is fluid build-up in the heart, liver and lungs. Chronic deficiency, as in alcoholics, leads to a build-up of lactic acid which damages nerves and manifests as pins-and-needles, burning pains, decreased reflexes and muscle weakness.

**Sources**
Our ‘friendly’ gut bacteria produce significant amounts.

Food sources are nuts (Brazil, cashews, pistachio, pine, walnuts, pecans, hazelnuts, macadamias), legumes (split peas, soya beans, lima beans, kidney beans, lentils, haricot beans), seeds (sunflower seeds, sesame seeds, tahini), whole grains (brown rice, rolled oats, whole wheat, rye) and the bran of the different grains. Very rich in thiamine are rice bran, oat bran and wheatgerm.

[Meats contain some thiamine, especially organ meats.]

**VITAMIN B2 – Riboflavin**

**Functions**
Required for the body to both break down and synthesise fats. Required for the ‘burning’ of sugar in the cells to provide energy. It activates folic acid. It helps protect the liver from carcinogenic chemicals.

**Stability**
Riboflavin is relatively stable at normal cooking temperatures, but unstable to light.

**Excretion**
It has a bright orange colour, which is why, after taking a supplement that includes riboflavin, the urine can be bright orange-yellow. Like all B-vitamins, it is water soluble and any excess is readily excreted in the urine.

Because of its easy excretion, riboflavin has no known toxicity – as with all B-vitamins – although commonsense should always prevail and the amount of supplement consumed should be as close to the body’s need as can be judged.

**Deficiency signs and symptoms**
The symptoms of established deficiency are widespread.

Early symptoms may include dizziness, tremor, vaginal itching and/or oily skin.

Advanced symptoms may include:

- **Eyes** – feel gritty, burning and itchy; are sensitive to light.
- **Mouth** – sore, inflamed, with burning lips, mouth and tongue.
- **Tongue** has characteristic appearance of smooth with deep furrows or pebbly ‘tongue’. Cracked lips and corners of mouth.
- **Skin** is red, scaly and oily, especially on face an groin area.

**Sources**
Our ‘friendly’ gut bacteria produce significant amounts.

Substantial food sources are: almonds, Brazil nuts, pistachio nuts, lesser amounts in other nuts, rice bran, wheat bran, wheatgerm, cheddar cheese, cottage cheese, ricotta cheese, yoghurt, eggs, mushrooms, sunflower seeds, sesame seeds, parsley, broccoli, cauliflower, red cabbage, green peas, spinach, silverbeet, soya beans, lentils, kidney beans, lima beans, rolled oats, wheat flour, rye flour. [Also fish, red meat.]

**VITAMIN B3 – Niacin**

**Functions**
Required for the processing of sugar, fat and protein, and therefore energy production. Activates the important folic acid. Required for hydrochloric acid production in the stomach. Required for vision.

**Stability**
Fairly stable to heat and light. Unlikely to be destroyed by cooking. Can be made in the body from the amino acid, tryptophan.

**Deficiency**
Gross deficiency causes *pellagra*, the disease of the ‘three Ds’ – dermatitis, diarrhoea, dementia.

- **Dermatitis** – skin has small blisters, red dry itchy patches or glossy.
- **Diarrhoea** – frequent, often not recognised.
- **Dementia** – poor concentration and memory, fatigue, depression, confusion, hallucination, paranoia.

**Sources**
Our ‘friendly’ gut bacteria produce significant amounts.

Substantial food sources are: rice bran, wheat bran, wheatgerm, sunflower seeds, sesame seeds, soya beans, lentils, kidney beans, lima beans, almonds, cashews, pine nuts, pistachio nuts, hazelnuts, other nuts (contain lesser amounts), wholewheat flour, rye flour, cheddar cheese, mushrooms, green peas. [Also fish, red meat.]

**VITAMIN B5 – Pantothenic acid**

**Functions**
Required for metabolism of sugar (‘burning’ for energy) and fat. Required for proper nerve function. Required for manufacture of adrenal steroids, including adrenalin. Required for manufacture of haemoglobin in red blood cells. Needed to produce antibodies. Helps detoxify a lot of medical drugs.

**Stability**
Unstable to heat, resulting in significant losses in cooking.

**Deficiency**
B5 deficiency is common, although often not recognised.

Effects are widespread, and especially in nerves.

- **Intestine** – abdominal pain, heartburn, vomiting, nausea, loss of appetite, gastritis, enteritis, diarrhoea if severe.
- **Skin** is red, scaly and oily, especially on face and groin area.
- **Mouth** – sore, inflamed, with burning lips, mouth and tongue.
- **Skin** is red, scaly and oily, especially...
Skin – loss of pigment, flaking of skin, hair falling out.
Nervous system – shooting pains in sciatic nerves, ‘burning’ in feet and ankles, pins-and-needles, low blood pressure and dizziness. In severe deficiency, muscle weakness, staggering gait.
Mental – apathy, fatigue, depression, sleep disturbances.
Liver – liver is fatty and enlarged.

Sources
Wheatgerm, mushrooms, eggs, soya beans, peanuts, other legumes, pecan nuts, cashews, hazelnuts, sunflower seeds, cabbage, broccoli, cauliflower, whole wheat, rye, avocado, brown rice.

VITAMIN B6 – Pyridoxine
Functions
- Has a key role in protein metabolism:
  - for absorption of amino acids in the small intestine;
  - for conversion of essential amino acids to non-essential amino acids;
  - for breakdown of excess amino acids;
  - for manufacture of the protein, haemoglobin, in red blood cells which carries oxygen to all cells.
- Needed for production of essential fatty acids and prostaglandins.
- Needed for production of stomach acid.
- Needed to produce antibodies for immunity.
- Works in partnership with magnesium to produce many enzymes.

Stability
Fairly stable to heat, but unstable to light.
- Easily absorbed.
- Alcohol and some drugs prevent B6 being usable in the body.

Deficiency
Symptoms somewhat similar to deficiency of B3 – involved are skin, intestine, nervous system and blood.
- Skin – dry, flaky dermatitis.
- Intestine – inflammation of mouth and gums, cracks in lips and corners of mouth, red swollen tongue, indigestion due to lack of stomach acid.
- Nervous system – increased excitability, leading to twitching, convulsions, seizures, pins-and-needles. Increased mental excitability leading to difficulty sleeping, irritability, nervousness, anxiety, depression. If severe in children, mental retardation.
- Blood – reduced haemoglobin can produce anaemia; decreased white cells can result in susceptibility to infection.

VITAMIN B9 – Folic acid, folate or folacin
Named after foliage, in which it is found abundantly.

Functions
Provides major protection against heart disease and stroke due to its leading role in converting the damaging amino acid, homocysteine, back to the very beneficial amino acids, methionine and cysteine. This anti-heart disease role was considered to be ‘the nutrient discovery of the 1990s’.
- Long known to be preventive of neural tube defects in the foetus, particularly spina bifida.
- Essential for the cell division process and is especially important for rapidly dividing cells, in particular, gut lining, skin and bone marrow. Interestingly, malignant tumours also have high folic acid requirements, which has led to drugs that tie up folic acid being used as a cancer treatment. The role of folic acid in enabling bone marrow to produce red blood cells makes it prominent in preventing anaemia.
- It is required for haemoglobin production.
- Required for production of choline from which lecithin is made. Lecithin is a key compound in the transport of fat and cholesterol in the bloodstream.

Stability
- Very unstable to heat and light. 15 minutes of cooking can destroy much of a food’s content of folic acid. Is the next most unstable vitamin after vitamin C.
- Alcohol, the contraceptive pill, anti-convulsant drugs and oral diabetic agents are antagonistic to folic acid.

Deficiency
One of the major vitamin deficiencies in the Western world.
- Major symptom is anaemia with red blood cells reduced in number, but large in size, called macrocytic or megaloblastic anaemia.
- White blood cells are reduced in number, leading to susceptibility to infections.
- The intestine does not repair its lining as rapidly as it should, leading to malabsorption, nutrient deficiencies and sore mouth and tongue.

Sources
‘Friendly’ gut bacteria produce significant amounts.
- Plant sources are generally richer than animal sources.
- Substantial food sources are: sunflower seeds, walnuts, hazelnuts, brown rice, wholemeal flour, bananas, avocado, peanuts, eggs, capsicum, spinach, green peas, eggs, raisins. [Also fatty fish.]

VITAMIN B12 – Cobalamin
A most interesting vitamin. Early last century, doctors were grappling with a form of anaemia that could not be cured by diet, so they labelled it pernicious anaemia. When doctors injected raw liver extract, it was cured, and they realised that something in the stomach enabled the mystery nutrient to be absorbed. They called this something the intrinsic factor and this is still its name today. The nutrient was labelled the extrinsic factor, which we now know as vitamin B12.
- It has a number of forms, the two that are active in human metabolism are methylcobalamin and deoxyadenosylcobalamin.
- Cobalamin is a critically important vitamin, because its deficiency can cause not only anaemia, but also brain damage.

Functions
B12 is essential for the cell division process and is especially important for rapidly dividing cells. As a result, it has a role in preventing anaemia identical to that of vitamin B9.
- It is also essential for proper functioning of the nerves throughout the body, including the mass of nerve tissue in the brain.

Stability
Stable at normal cooking temperatures. Unstable to acid, alkali and large doses of supplementary vitamin C and vitamin E.

Absorption
The intrinsic factor carries B12 through the stomach acid and into the alkaline medium of the small intestine where it can be absorbed. If the intrinsic factor is lacking, the B12 cannot be absorbed, and the person must have it injected directly into the bloodstream (which is effective).
- Shortage of the intrinsic factor can be caused by:
  - Atrophy (shrinkage) of the stomach lining due to alcoholism, deficiencies of vitamin B12 or folic acid or stress;
  - Corrosive chemicals, such as caustic soda used to make beans greener;
  - Auto-immune damage.

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Poor absorption in the small intestine can be a consequence of coeliac disease, Crohn's disease, pancreatic disease, intestinal worms or drugs such as neomycin, The Pill, oral diabetic agents or alcohol.

**Storage in the body**

B₁₂ is the only B-vitamin that is stored in the liver for long periods. Up to 1,000 micrograms can be stored, which is enough to last possibly three years if none is consumed.

**Deficiency**

Anaemia and susceptibility to infections due to decreased red and white blood cells respectively.

Mental symptoms - depression, mania, paranoid and personality changes.

Nerve damage symptoms, known as subacute combined degeneration of the spinal cord - pins-and-needles, numbness, nerves inflamed and tender, poor coordination and, if severe deficiency, paralysis.

B₁₂ and folic acid have overlapping functions.

If both are deficient, all the above symptoms are likely;

If folic acid deficient, but adequate B₁₂, can have anaemia, but no mental or nerve symptoms;

If folic acid adequate, but B₁₂ deficient, there will be no anaemia, but likely to have mental and nerve symptoms.

**Sources**

B₁₂ in food is bound to protein, that is, chelated.

Because usable B₁₂ occurs only in animal foods (or supplements), it has been assumed that people on all-plant diets must depend on supplements. However, many people on vegan diets have been found to have adequate blood levels, demonstrating that the B₁₂ produced abundantly by the friendly gut bacteria is available to the body. But if the gut bacteria have been reduced by courses of antibiotics, their production of B₁₂ may be insufficient.

B₁₂ occurs at modest levels in eggs and cheese. [Organ meats and flesh foods contain plenty.] The RDI for adults is 2 micrograms. One large egg or 100 gm cheese supplies about 1 microgram.

Any B₁₂ in plant foods is an analogue that cannot be used by the body.

People on vegetarian diets are strongly advised to have levels checked periodically by a doctor. So should people who consume meat in case of intrinsic factor deficiency.

Supplements are readily available and are effective.

**VITAMIN B₁₅**

Pangamic acid

'Pangamic' means 'all seeds' and that is where it is found.

**Functions**

B₁₅ increases the efficiency of obtaining energy from blood sugar.

It is a methyl donor, meaning it is necessary for the body to produce adrenal, cortisone, choline and RNA.

It detoxifies chemicals in the liver, including alcohol, DDT, cyanide, chloroform, aspirin.

The net effects of these functions are that B₁₅ improves athletic performance and memory, eases stress, reduces alcoholism and helps prevent atherosclerosis (artery disease) and gout.

**Deficiency**

There are no recognised deficiency symptoms.

**Sources**

The seeds of apricots, other stone fruits, apples and all other fruits.

Whole grains, wheatgerm and bran.

**VITAMIN B₁₇**

Amygdalin, Laetrile

This anti-tumour agent is highly controversial because there is substantial evidence that it prevents and possibly reverses cancer, but the drug companies cannot patent a nutrient, so it has been more or less black-banned by orthodox medicine. However, it is neither a drug nor a food additive; it is a nutritional supplement and should be readily available.

Vitamin B₁₇ was given prominence by the journalist, Edwin Griffin, in his classic book, *World Without Cancer*. The book details how B₁₇ prevents cancer and destroys cancer cells, then elaborates on how vested interests have succeeded in making supplements virtually illegal.

Vitamin B₁₇ was prominent in the diets of early populations that had no cancer, including the Hunzas and the Abkazians.

**Functions**

Leading scientists have claimed that amygdalin makes it extremely unlikely that cancer will develop, and that amygdalin will kill existing cancer cells.

**Sources**

The greatest concentration is found in the seeds of the rosaceous fruits, including apricot pits, bitter almonds and other bitter nuts. Other sources are: the seeds of apples, cherries, nectarines, peaches, pears, plums, prunes. There are lesser amounts in chickpeas, sprouted lentils, lima beans, sprouted mung beans, macadamia nuts, cashews, most wild berries (blackberries, cranberries, elderberries, raspberries, strawberries), flaxseeds, sesame seeds, oats, barley, brown rice, buckwheat, millet, rye, wheat.

**BIOTIN**

Is considered to be a B-vitamin.

Its functions include roles in: helping maintain blood sugar level; synthesis of fatty acids; manufacture of cholesterol (a very important substance); increasing the production of B₁₂ by the gut bacteria.

Deficiency does not occur readily in adults, but can occur in children. On the other hand, biotin is used for treating baldness and greying of hair.

**Sources.** The gut bacteria are a major source. Food sources include: royal jelly (very rich), egg yolk, soya beans, peanuts, lentils, nuts, brown rice.

**CHOLINE AND INOSITOL**

These nutrients are sometimes called B-vitamins.

Choline is made from the amino acid, *methionine*, and is required for the nervous system, for the manufacture of lecithin and as a methyl donor for making adrenal, cholesterol, etc. It also protects the liver from certain toxic chemicals.

Inositol is somewhat similar to choline. It is made from glucose in the liver, and is required for the manufacture of lecithin, for fat transport and for the making of the *myelin* in nerve sheaths. It is part of cell walls.

Deficiency symptoms for choline have not been established because the body can make it from methionine; however, it is known that deficiency of choline can cause fatty liver.

Any effects of inositol deficiency have not been established, but probably result in fatty liver.

Choline sources include eggs, soy beans, wheatgerm, brown rice, lecithin supplement.

Inositol sources include soya beans, chick peas, lima beans, brown rice, other whole grains, citrus fruits, tomatoes, cabbage.

**VITAMIN A – Retinol**

Vitamin A is found in the fat of animal tissues and gives the yellow colour to cream, butter and fat on meat. It does not need to be consumed because it can be made in the human body from carotenes in plant foods.

**Carotenens and vitamin A**

In our bodies, vitamin A can be made from *provitamin-A carotenoids*, including the well known beta-carotene as well as alpha-carotene and beta-cryptoxanthin.

Nutritionists talk about *retinol equivalent*, which is the amount of vitamin A that can be produced from the carotene content of a food. When nutritionists talk about vitamin A in plants, they are actually referring to the provitamin-A carotene content.
The carotenoid family, of which there are about 600 members, occur only in plant foods. They are fat-soluble. Some are brightly coloured, such as the beta-carotene in carrots and rockmelon and the lycopene in tomatoes, watermelon and pink grapefruit.

Functions
It's true – carrots do help us see in the dark. Their beta-carotene is converted to vitamin A which is necessary for vision – it plays a key part in the mechanism of sight.

Necessary for maintaining mucous membranes and their production of mucus. Mucous membranes line the intestines, respiratory tract, urinary tract and genital organs. It helps prevent cells from changing to cancer cells, as in the case of the mucous lining of the lungs of a person who smokes.

Necessary for proper immune function.

Stability
Vitamin A is fat-soluble, stable to heat, but unstable to light and air, hence destroyed by frying.

Information on the stability of carotenoids is scarce, but it appears that they are stable to the heat of cooking.

Excretion
Not readily excreted as are the water-soluble B-vitamins.

Deficiency
Lack of vitamin A commonly first shows up as 'night blindness', meaning can't see in dim light.

Membrane of the eyes (conjunctiva) becomes dry, red and sore and there is no tear production.

Skin becomes dry, there is dandruff.

Nails become brittle.

Infections increase in the mucous membranes of the various organs and tracts.

Toxicity
Excessive doses of vitamin A can produce toxicity symptoms because vitamin A is poorly excreted. Symptoms can include nausea, joint pain, headache, dry flaky skin, loss of hair, mental disturbances and liver dysfunction. When the supplement is discontinued, symptoms usually subside in a matter of days.

Excessive intake of carotenes – as in the case of drinking large amounts of carrot juice daily – can cause carotenaemia in which the creases in the palms of hands, soles of feet, elbows, knees and groin become yellow. This is not toxic or dangerous, and the colour disappears after intake ceases.

Sources
Vitamin A is found in the yellow fat/oil of animal products.

The provitamin-A carotenes are found in many plant foods. Some common sources from the richest down are: carrot, parsley, pumpkin, mango, English spinach, red capsicum, sweet potato, lettuce, silverbeet, green peas, broccoli, green beans, tomatoes, zucchini, avocados, sweet corn, apricots.

VITAMIN D – Calciferol
Vitamin D is the 'sunshine vitamin' because it is manufactured in the body when sunlight is falling on the skin. Strictly speaking, when it is made in the body, it is a hormone, not a vitamin. But when it is consumed in food, it is still a vitamin, so for convenience, it is always referred to as a vitamin.

Functions
Bones. Vitamin D is well known for its role in maintaining strong bones through its regulation of calcium and phosphorous and increasing their absorption in the small intestine. Now it is also known for a string of protective functions, including substantial cancer prevention.

Cartilage. Vitamin D helps maintain strong cartilage in joints, and can reduce the need for joint replacement.

Immunity. It stimulates white blood cells to inhibit viruses and dampens down the inflammatory mechanism, reducing the incidence of upper respiratory tract infections.

Cancer. Vitamin D has a role in regulating cell growth and differentiation, making it a strongly anti-cancer nutrient.

Auto-immune diseases. It is preventive against multiple sclerosis, sjogren's syndrome, rheumatoid arthritis, thyroiditis and crohn's disease.

Diabetes and heart disease. It helps prevent the insulin resistance that leads to diabetes and often heart disease.

Depression and seasonal affective disorder. It helps prevent both of these conditions.

Obesity. Vitamin D supports the production of the hormone, leptin, which signals the brain when fat cells are full and that appetite is satisfied.

Stability
Like vitamin A, vitamin D is fat-soluble and stable to heat, but unstable to light and oxygen, and destroyed by frying.

Storage
A lot of vitamin D can be stored in the liver; we make plenty in summer and the store may carry us through winter.

Deficiency
Bones. Deficiency results in low blood levels of calcium and phosphorous. When this is severe, bones become soft, deformed and bent. In children this disease is rickets; in adults it is osteomalacia (this is not osteoporosis in which bones become porous and break easily).

Minor infections – increased susceptibility to these.

Cancer – increased incidences of four of the most common cancers – breast, prostate, colon and skin – along with other cancers.

Auto-immune diseases – increased incidences of these. MS becomes more common the further people live from the equator.

Diabetes and heart disease – increased risk.

Depression – low vitamin D is believed to contribute to chronic depression.

Obesity.

Toxicity
High levels in the body can be toxic. This won't occur from sunshine or food, but with concentrated sources like cod liver oil or supplements.

Sources
Natural vitamin D is made in the skin from cholesterol, and is known as vitamin D3 or cholecalciferol. The synthetic form is called vitamin D2.

Sunlight is now considered to be the ideal way to obtain vitamin D, that is, vitamin D3.

Sunshine provides optimal levels naturally because the body has a built-in 'fail-safe' mechanism which shuts down production when blood levels are optimal.

In strong sunshine, bare skin needs at least 10 – 15 minutes of exposure to direct sunlight every day to produce enough vitamin D. In milder sunshine, it might be around 15 to 30 minutes per day, with the more of the skin exposed, the better, preferably about 40 percent. Broadly speaking, we appear to need anywhere from 15 minutes to two hours a day, depending on whether skin is 'white' or well pigmented and on latitude, season, cloud cover, etc.

In foods vitamin D is relatively rare, and is only available in animal products and in limited quantities – eggs, liver and fatty fish, and that well known source, cod liver oil.

In high latitudes distant from the equator, there may be insufficient sunlight, as, for example, in tasmania. The option is supplementation with vitamin D3, which is easily done, provided blood levels are checked to avoid overdosing. It is better not to use synthetic vitamin D2 because it is toxic at higher doses.

[For more details of how vitamin D prevents cancer, see the article 'How Sunshine Can Prevent Cancer', p.14 in this issue.]
VITAMIN E – Tocopherols and Tocotrienols

There are eight nutrients in food that have vitamin E activity: alpha-, beta-, gamma- and delta-tocopherol and alpha-, beta-, gamma- and delta-tocotrienol. When nutritionists talk about vitamin E, they are mostly referring to alpha-tocopherol, yet recent research has discovered that tocotrienols are powerfully, anti-cancer and protective of nerves. All eight members of the vitamin E family have beneficial functions that go well beyond those of alpha-tocopherol.

**Functions**

Vitamin E has one major role – it is a powerful antioxidant, protecting lipids, hormones, DNA and enzymes from oxidation especially by free radicals. This singular role manifests in a vast array of beneficial functions:

- Heart protection by protecting the energy store in heart muscle.
- Prevention of free-radical damage to arteries.
- Prevention of a build-up of lactic acid which can damage arteries.
- Preservation of the shape of red blood cells, preventing their premature destruction.
- Required for fertility, protecting the oxygen supply to the reproductive organs and transporting sex hormones.
- Assists the functioning of the immune system.
- Needed for the production of thyroid hormones.
- Protects against some cancer-forming chemicals.
- Reduces radiation damage to the skin and so reduces the appearance of ageing.

**Stability**

As with vitamins A and D, vitamin E is fat-soluble and stable to heat, but unstable to light and oxygen, and destroyed by frying.

Although vitamin E is a powerful antioxidant, it is easily oxidised itself because this is how it provides protection.

There is very little storage in the liver.

**Deficiency**

Lack of energy for heart muscle, and damage to heart and arteries.

Anaemia through loss of red blood cells, including neonatal jaundice.

Infertility.

Increased susceptibility to infections.

The appearance of premature ageing.

Increased risk of cancer.

**Sources**

Requirements of vitamin E are related to selenium intake. The selenium-containing enzyme, glutathione peroxidase, blocks free radicals, reducing the need for vitamin E. The more selenium taken in, the less E is required, and vice-versa.

Food sources of vitamin E include (from the richest down): wheatgerm oil, soya bean oil, corn oil, sesame oil, peanut oil, hazelnuts, almonds, olive oil, sunflower oil, Brazil nuts, peanuts, millet, brown rice, butter, eggs.

Supplements need to be selected with care. The natural form of tocopherol is d-alpha-tocopherol which has a right-handed molecule. Synthetic supplements contain d- and l-alpha-tocopherol which is both left- and right-handed and is not natural; nobody knows the long-term consequences of taking these. The most effective supplement is one containing all eight tocopherols and tocotrienols.

A natural supplement is wheatgerm oil capsules.

Toxicity is possible with supplements, the main danger being high blood pressure.

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VITAMIN K – Naphthaquinone

**Functions**

Just one function – the production of compounds that are part of the blood clotting process that arrests bleeding due to injury.

**Stability**

Is fat-soluble and stable in much the same way as the other fat-soluble vitamins.

**Deficiency, Toxicity**

If vitamin K is deficient, there is a tendency to bleed too easily and too much.

Newborn babies are prone to haemorrhagic disease in which there is bleeding from the gut and elsewhere; they vomit blood and it comes out the nose. Babies have no vitamin K until the gut bacteria become established, which is why hospitals routinely inject K.

But like all medical procedures this has risks. It can cause allergic reactions all the way up to anaphylactic shock, and has been reported to double the risk of leukaemia. The alternative, says naturopath Robyn Chuter in this magazine (Winter 2001 issue, page 30), is for the pregnant woman to ensure a high intake of vitamin-K-rich foods and breastfeed as soon as possible after the birth. The colostrum will then be rich in K.

There is no toxicity from natural vitamin K. With synthetic vitamin K there can be.

**Antagonist to anti-coagulant drugs**

It is well known that a person on warfarin needs to avoid food sources of vitamin K. These drugs reduce clotting by inhibiting vitamin K, and won’t work if a person is taking high doses of the vitamin.

**Sources**

The gut bacteria are the major source.

The richest foods sources are green leafy vegetables – turnip greens, broccoli, lettuce, spinach, alfalfa sprouts, etc. Containing good levels are asparagus, cauliflower, soya beans, eggs and green and white teas.

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